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(54) Improvements in or relating to flange locks.

(57) A flange lock for securing a disk 8 on the spindle 10 of a power tool is described. It comprises a boss 11 screwable on the spindle and inner and outer flanges 4,1 non-rotatably mounted on said boss 11 so as to be relatively movable thereon between a first, separated relation rigid with said boss and a second, less separated relation. Separation balls 5 are mounted between the flanges 4,1 and disposable between a first condition in which the flanges are maintained in the first, separated relation and a second condition in which the flanges 4,1 are able to move relatively together to the second, less separated condition. An actuator 2 disposes the separation balls 5 between said two conditions in such a manner that by screwing the flange lock on to the power tool spindle 10 to secure a disk 8 thereon by engaging the inner flange 4 against the disk 8 with the flanges 4,1 maintained in the first, separated condition so that the flanges are pressed together through the separation balls 5, disposal of the separation balls to the second condition will serve to relieve the pressure between the flanges whereby unscrewing of the flange lock is facilitated (Figure 1).

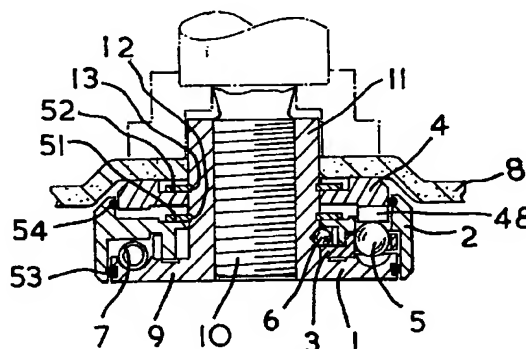


FIG. 1

This invention relates to flange locks for securing rotary disks on to the spindles of power tools, such as a grinding wheel on to the spindle of an angle grinder or a circular saw blade on to the spindle of a circular saw.

Conventionally the spindles of such tools are screw threaded and the disks have been secured by a lock nut which is locked in place by a spanner and which must also be released by use of the spanner. More recently flange locks have been developed which can be safely secured and released by hand without the use of a tool and examples of such flange locks are to be found in US Patents Nos. 4850154, 4941790 and 5042207, and European Patent Application 0381809.

It is an object of the present invention to provide an improved flange lock which can be secured and released by hand.

To this end, from one aspect, the invention provides a flange lock for securing a disk on the spindle of a power tool, comprising a boss screwable on the spindle, inner and outer flanges non rotatably mounted on said boss so as to be relatively movable thereon between a first, separated relation rigid with said boss and a second, less separated relation, separation means mounted between said flanges and disposable between a first condition in which said flanges are maintained in said first, separated relation and a second condition in which the flanges are able to move relatively together to said second, less separated condition, and means for disposing said separation means between said two conditions in such a manner that by screwing the flange lock on to the power tool spindle to secure a disk thereon by engaging said inner flange against the disk with said flanges maintained in said first, separated condition so that the flanges are pressed together through said separation means, disposal of said separation means to said second condition will serve to relieve the pressure between said flanges whereby unscrewing of the flange lock is facilitated.

Preferably, the outer flange is fixed rigid with said boss and the inner flange is movable inwardly along the boss to a limit position.

In a preferred form, the separation means comprises a plurality of elements spaced around said flanges and movable between first positions in which they cooperate with said flanges to maintain said flanges in said first separated condition and second positions in which the flanges are able to move relatively together to said second, less separated condition, and means are provided for releasably holding said elements in said first positions, said elements being movable to second positions upon release of said holding means by the flanges being pressed together. Suitably, the separation elements are in the form of rolling members, such as balls, which co-operate with ramp means on said flanges.

From another aspect, the invention provides a flange lock for securing a disk on the spindle of a power tool, comprising a boss screwable on the spindle, an outer flange fixed rigid with said boss and an inner flange non-rotatably mounted on the boss but axially movable thereon between an inner limit position in which the flanges are in a first, separated condition and a second position in which the flanges are in a second, less separated condition, a plurality of balls mounted between said flanges and movable between first positions in which they co-operate with ramp means on said flanges to maintain said flanges in said first, separated condition and second positions in which the inner flange is able to move towards the outer flange to said second, less separated condition, and means for releasably holding said balls in said first positions in such a manner that when the flange lock is screwed on to the power tool spindle to secure a disk thereon by engaging said inner flange against said disk with said flanges maintained in said first, separated condition so that said flanges are pressed together through said balls, release of said holding means will result in said balls being urged by said pressure along said ramp means to said second positions whereby the pressure between the inner flange and the disk is relieved and unscrewing of the flange lock is facilitated.

In such an arrangement, the ramp means suitably comprise inclined surfaces on one or both of said flanges, and each flange desirably has a number of ramps equal to the number of balls arranged in facing pairs along which said balls are movable. Furthermore, the ramps preferably extend circumferentially and means are provided for guiding said balls circumferentially along said ramps.

In a preferred embodiment, spring means urge said balls into said first positions, and the holding means includes a ring member mounted for limited rotation on the boss intermediate said flanges and rotatable in the direction in which the flange lock is screwed on to the spindle to a first limit position in which said balls are locked in said first positions thereof adjacent the upper ends of the ramps, rotation of the ring member in the opposite direction relative to the boss to a second limit position releasing the balls to permit them to run down the ramps. There are ideally three said balls equally spaced around the flange lock by a cage member rotatably mounted on the boss intermediate said flanges, said cage member including an annular wall member circumferentially between an inner face of said ring member and said boss, this wall member having an opening there-through in which a locking ball larger than the thickness of the wall is positioned, said boss including a recess which in said first limit position of said ring member corresponding to the first positions of the separation balls is aligned with said opening and said locking ball is held partly in said opening and partly in said

recess by said inner face of the ring member thus locking the cage against rotation relative to the boss (and thus the flanges), rotation of said ring member to its second limit position aligning a recess in said inner face of said ring member with said opening in said annular wall of said cage member allowing the locking ball to disengage from the recess in the boss and permit the cage member to rotate relative to the boss so that the balls can move down said ramps. Suitably, the opening in the annular wall member of said cage member is inclined in the direction in which said separation balls move down the ramps. A preferred arrangement includes three of the locking balls each engaging associated openings and recesses.

From a still further aspect, the invention provides a flange lock for securing a disk on the spindle of a rotary tool, comprising a boss screwable on the spindle, an outer flange rigid with the boss and mounted on the outer end thereof, an inner disk-engaging flange non-rotatably mounted on the boss inwardly of the first flange and slidable on the boss away from said outer flange to a limit position, co-operating circumferentially extending ramp means on said flanges, a plurality of balls mounted between the first and second flanges for movement along said ramp means between first rotary positions in which the balls co-operate with said ramp means to produce maximum separation of said flanges with said inner flange in its limit position and second rotary positions in which said inner flange can move towards said outer flange, spring means urging said balls to said first rotary positions, releasable locking means for locking said balls in said first rotary positions in which the flanges are separated with said inner flange in its limit position, and a ring member mounted on said boss intermediate said flanges for rotation between a first rotary limit position in which the releasable locking means is engaged and a second rotary limit position in which said locking means is disengaged whereby the pressure between said flanges created by screwing the flange lock onto a disk with the flanges separated by said balls raised up said ramp means can be relieved by releasing the balls such that they run down said ramp means due to the pressure of the flanges thus relieving the pressure between the inner flange and the disk and facilitating removal of the lock flange.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings, in which:-

Figure 1 is a cross section through one embodiment of flange lock according to the present invention showing the flange lock securing a grinding disk on the spindle of an angle grinder;

Figure 2 is an exploded perspective view of the flange lock of Figure 1 from the front or outer end thereof;

Figure 3 is an exploded perspective view of the flange lock from the back or inner end thereof;

Figure 4 is a horizontal cross section of the flange lock looking from the inner end or back thereof in the first separated condition of the lock;

Figure 5 is a sectional view like that of Figure 4 showing the second, less separated condition of the flange lock;

Figure 6 is a schematic illustration of the relationship of a separation ball with ramps on the flanges of the flange lock;

Figure 7 is a partial cross section through the boss and integral outer flange;

Figure 8 is a view of the element of Figure 7 looking from the left in Figure 7 i.e. the back or inner side of the flange lock;

Figure 9 is a circumferential section taken along the ramps of the outer flange shown in Figure 8; Figure 10 shows the back side of the cage member of the flange lock;

Figure 11 is a section along the line XI-XI of Figure 10;

Figure 12 shows the front side of the ring member of the flange lock;

Figure 13 shows the back side of the ring member;

Figure 14 is a section along the line XIV-XIV of Figure 12;

Figure 15 is a view from the front side of the inner flange of the flange lock;

Figure 16 is a cross section through the inner flange of Figure 15; and

Figure 17 is a circumferential partial section along the line XVII-XVII of Figure 15.

Referring now to the drawings, the flange lock is shown as used to clamp a grinding wheel or disk 8 on the spindle 10 of an angle grinder. It could also be used to clamp other rotating elements on to spindles such as a circular saw blade on the spindle of a circular saw. The flange lock consists of four major elements; a support member 1 comprising a flange 9 integrally mounted on the outer end of a sleeve-like centre portion or boss 11 which is threaded internally for threading on to the spindle 10 of the angle grinder; a ring element 2 which is rotatably mounted on the boss 11 of the support member 1; a disk-like cage element 3 which is also rotatably mounted on the boss 11 of the support member 1 between the flange 9 and the ring 2; and a clamping flange 4 non-rotatably mounted on the boss 11 of the support member 1 over the ring 2.

The elements 1, 2 and 3 are held against relative axial movement by a circlip 51 engaging in a groove 12 in the boss 11 which prevents axial movement of the elements 2 and 3 along the boss 11. Rotational movement of the clamping flange 4 on the boss 11 is prevented by co-operating flats 42, 11a on the disk 4 and boss 11 respectively. Axial movement of the flange 4 along the boss 11 is limited by the circlip 51 and a second circlip 52 which engages in a groove 13

in the boss 11.

The disk-like cage 3 has projections 31 containing holes 35 which receive support balls 5. The balls 5 fit between the flange 9 and the clamping flange 4 to maintain separation between these two elements. The degree of separation of the flange 9 and flange 4 depends on the position of the balls 5 with respect to circumferentially extending inclined surfaces or ramps 18, 48 on the flanges 9 and 4 respectively.

Rotation of the cage 3 in the clockwise direction relative to the flange 9 (looking towards the front of the grinding disk) is limited by three pins 7a standing up from the flange 9 which engage one side of each of the ball carrying projections 31 of the cage 3 and are normally pressed against the projections 31 by three compression springs 7 which extend between the pins 7a and pins 7b which project downwardly from the ring 2 intermediate the cage projections 31.

The cage 3 has an annular groove 32 extending along in its upper face (looking towards the back of the grinding disk i.e. from the inner side of the flange lock). In the radially inner face of the groove 32 are three radially inwardly extending slots 33 angled outwardly in the anti-clockwise direction. A small lock ball 6 fits in each slot 33. These slots 33 are aligned with recesses 14 in the outer circumferential face of the boss 11 of the support member and the balls 6 sit partly within the slots 33 and partly inside the recesses 14 in the boss of member 1. Between each slot 33 a short circumferential slot 34 is formed in the base of the groove 32.

The ring 2 fits over the cage 3 and is rotatable relative to the support member 1. The front side face of the ring 2 (i.e. the face away from the grinding disk) has an annular rib 21 which fits in the annular groove 31 in the cage 3. Three pins 22 standing up from the annular rib 21 engage in the circumferential slots 34 of the cage. Three recesses 26 are provided in the radially inner face of the rib 21. Three circumferential slots 24 are provided in the ring 2 outwardly of the rib 21 and in alignment with the balls 5 to allow free movement of the balls relative to the ring 2 and at the same time to allow the balls to engage through the ring 2 with the flange 4.

The flange 4 fits over the ring 2 being non-rotatably counted on the boss 11 of the support member 1 by means of flats 42 engaging the corresponding flats 11a on the boss 11. The flange 4 can move axially on the boss 11, its axial movement being limited by the second circlip 52.

Before the flange lock is fitted on to the spindle of an angle grinder or the like (i.e. the rest position) the relationship of the parts is as follows.

The projections 31 of the cage 3 are pressed against the pins 7a of the flange 1 by the intermediary of the springs 7 pressing against the pins 7b of the ring 2. The pins 22 of the ring 2 in turn press against the ends of the slots 34 in the cage 3 to press

the projections 31 of the cage 3 against the pins 7a. In this position the balls 5 are at the upper ends of the ramps on both the flange 1 and the flange 4 and the flange 4 is pressed against the circlip 52. Furthermore in this position the slots 33 in the cage 3 are aligned with the recesses 14 in the boss 11 and the recesses 26 are out of alignment with the slots 33 so that the inner face of the rib 21 holds the balls 6 in the slots 33 and recesses 14 so that the balls 6 lock the flange 1 and cage 3 against relative rotation.

When the flange lock is rotated on to the spindle by gripping the ring 2 the above condition is maintained since the rotation is in the direction which maintains the condition, i.e. the ring 2 urging the cage 3 into the position in which the projections 31 engage the pins 7a. The flange lock is tightened on to the grinding disk 8 with the flanges 9 and 4 remaining spaced by the balls 5 held between the ramps 18 and 48. The support member 1 is screwed on in the direction of rotation of the grinding disk so that it becomes tighter as the disk rotates.

In order to release the flange lock, the ring 2 is rotated anti-clockwise against springs 7 which results in the following. The recesses 26 move into alignment with the slots 33 and the balls 6 are now moved outwardly by the load on the flange 4 tending to move the balls 5 down the ramps 18, 48 thus rotating the cage 3 anti-clockwise relative to the flanges 9 and 4. As soon as the balls 6 move outwardly the lock between cage 3 and support member 1 is released and the cage 3 rotates relative to the flanges 9 and 4 (against the springs 7) to allow the balls 5 to run down the ramps 18, 48 and the flange 4 to move axially down the boss 11 thus relieving the pressure between the flange 4 and the grinding disk 8 so that the user can now relatively easily unscrew the flange lock by continuing to rotate the ring 2 anti-clockwise.

The maximum rotational movement of the cage against the spring action is about 15°. For release of the mechanism as described above less than 15° of movement is required.

Rubber seals 53 and 54 are provided between the ring 2 and flange 9 and flange 4 respectively to prevent the ingress of dirt.

While a particular embodiment of the invention has been described it will be understood that various modifications and variations may be made to the specific details referred to herein. For example, while in the embodiment illustrated separation balls 5 have been described it will be understood that other slidable elements, particularly rolling elements may be utilised.

## Claims

1. A flange lock for a disk (8) to be secured on a threaded spindle (10) against a shoulder on said

spindle, the lock comprising:-

- a) a boss (11) for threaded engagement on said spindle;
  - b) a flange (1) on the end of the boss;
  - c) a separation flange (4) non-rotatably mounted on the boss between said flange and the disk to be secured;
  - d) circumferential ramps (18,48) being arranged on at least one of the facing surfaces of said flanges;
  - e) low friction bodies (5) are disposed on said ramps between said flanges and serve to separate them;
  - f) a cage (3) locates said bodies; and
  - g) a release member (2) locks said cage in a first position in which said flanges have a maximum separation and releases said cage whereby said bodies can move to a second position in which said flanges have a reduced separation.
2. A flange lock as claimed in Claim 1 characterised in that said cage has a sleeve which is a close sliding fit on said boss, said sleeve has windows (33) housing locking elements (6) having greater radial extension than the thickness of said sleeve and in that said release member is a close sliding fit on said sleeve in the region of said windows and has notches (26) in said second position of the member with respect to the cage to receive said locking elements, detents (14) being provided in said boss into which said locking elements extend when said release member is in its first position and whereby said cage and boss are locked together.
  3. A flange lock as claimed in Claim 2 characterised in that said ramps are arranged so that, in the tightening direction of rotation of said boss on said spindle, said elements ride up the ramps towards said first position.
  4. A flange lock as claimed in Claim 3 characterised in that said cage is spring biased towards said first position.
  5. A flange lock as claimed in Claim 4 characterised in that springs (7) act between a stop (7a) on said flange and a stop (7b) on said release member, dogs (22) on the release member engaging circumferential slots (34) in said cage
  6. A flange lock as claimed in Claim 3, 4 or 5 characterised in that rotation of said release member in the loosening direction of rotation of said boss on said spindle from said first position and relative to said cage, brings said notches into register with said windows whereby said locking elements

are permitted to exit said detents and enter said notches and release said cage relative to said boss, whereby said bodies ride down said ramps reducing the separation of said flanges.

7. A flange lock as claimed in Claim 6 characterised in that said windows have oblique side walls, so that, on rotation of the release member in said tightening direction relative to said cage, one wall tends to guide said locking elements radially inwardly as they are engaged by one end of said notches.
8. A flange lock for securing a disk on the spindle (10) of a power tool, comprising a boss (11) screwable on the spindle, inner (4) and outer (1) flanges non-rotatably mounted on said boss so as to be relatively movable thereon between a first, separated relation rigid with said boss and a second, less separated relation, characterised in that separation means (5) are mounted between said flanges and disposable between a first condition in which said flanges are maintained in said first, separated relation and a second condition in which the flanges are able to move relatively together to said second, less separated condition, and means (31) for disposing said separation means between said two conditions in such a manner that by screwing the flange lock on to the power tool spindle to secure a disk thereon by engaging said inner flange against the disk with said flanges maintained in said first, separated condition so that the flanges are pressed together through said separation means, disposal of said separation means to said second condition will serve to relieve the pressure between said flanges whereby unscrewing of the flange lock is facilitated.
9. A flange lock as claimed in Claim 1 characterised in that said outer flange (1) is fixed rigid with said boss (11) and said inner flange (4) is movable inwardly along the boss to a limit position
10. A flange lock as claimed in Claim 1 or 2, characterised in that said separation means comprises a plurality of elements (5) spaced around said flanges and movable between first positions in which they co-operate with said flanges to maintain said flanges in said first separated condition and second positions in which the flanges are able to move relatively together to said second, less separated condition, and in which means (3) are provided for releasably holding said elements in said first positions, said elements being movable to second positions upon release of said holding means by the flanges being pressed together.

11. A flange lock as claimed in Claim 10 characterised in that the separation elements are in the form of rolling members such as balls which co-operate with ramp means on said flanges.

12. A flange lock for securing a disk on the spindle of a power tool, comprising a boss screwable on the spindle, an outer flange fixed rigid with said boss and an inner flange non-rotatably mounted on the boss but axially movable thereon between an inner limit position in which the flanges are in a first separated condition and a second position in which the flanges are in a second less separated condition, plurality of balls mounted between said flanges and movable between first positions in which they co-operate with ramp means on said flanges to maintain said flanges in said first separated condition and second positions in which the inner flange is able to move towards the outer flange to said second, less separated condition, and means for releasably holding said balls in said first positions in such a manner that when the flange lock is screwed on to the power tool spindle to secure a disk thereon by engaging said inner flange against said disk with said flanges maintained in said first, separated condition so that said flanges are pressed together through said balls, release of said holding means will result in said balls being urged by said pressure along said ramp means to said second positions whereby the pressure between the inner flange and the disk is relieved and unscrewing of the flange lock is facilitated.

13. A flange lock as claimed in Claim 12, characterised in that said ramp means comprises inclined surfaces on one or both of said flanges.

14. A flange lock as claimed in Claim 13, characterised in that each flange has a number of ramps equal to the number of balls arranged in facing pairs along which said balls are movable.

15. A flange lock as claimed in Claim 14, characterised in that said ramps extend circumferentially and means are provided for guiding said balls circumferentially along said ramps.

16. A flange lock as claimed in Claims 13, 14 or 15 characterised in that it includes spring means urging said balls into said first positions.

17. A flange lock as claimed in Claim 16, characterised in that said holding means includes a ring member mounted for limited rotation on the boss intermediate said flanges and rotatable in the direction in which the flange lock is screwed on to the spindle to a first limit position in which said

balls are locked in said first positions thereof adjacent the upper ends of the ramps, rotation of the ring member in the opposite direction relates to the boss to a second limit position releasing the balls to permit them to run down the ramps.

18. A flange lock as claimed in any one of Claims 12 to 17 characterised in that it includes three said balls equally spaced around the flange lock by a cage member rotatably mounted on the boss intermediate said flanges.

19. A flange lock as claimed in Claims 17 and 18, characterised in that said cage member includes an annular wall member circumferentially between an inner face of said ring member and said boss and said wall member has an opening there-through in which a locking ball larger than the thickness of the wall is positioned, said boss includes a recess which in said first limit position of said ring member corresponding to the first positions of the separation balls is aligned with said opening and said locking ball is held partly in said opening and partly in said recess by said inner face of the ring member thus locking the cage against rotation relative to the boss (and thus the flanges), rotation of said ring member to its second limit position aligning a recess in said inner face of said ring member with said opening in said annular wall of said cage member allowing the locking ball to disengage from the recess in the boss and permit the cage member to rotate relative to the boss so that the balls can move down said ramps.

20. A flange lock as claimed in Claim 19, characterised in that said opening in the annular wall member of said cage member is inclined in the direction in which said separation balls move down the ramps.

21. A flange lock for securing a disk on the spindle of a rotary tool, comprising a boss screwable on the spindle, an outer flange rigid with the boss and mounted on the outer end thereof, an inner disk-engaging flange non-rotatably mounted on the boss inwardly of the first flange and slidable on the boss away from said outer flange to a limit position, co-operating circumferentially extending ramp means on said flanges, a plurality of balls mounted between the first and second flanges for movement along said ramp means between first rotary positions in which the balls co-operate with said ramp means to produce maximum separation of said flanges with said inner flange in its limit position and second rotary positions in which said inner flange can move towards said outer flange spring means urging said

balls to said first rotary positions releasable locking means for locking said balls in said first rotary positions in which the flanges are separated with said inner flange in its limit position, and a ring member mounted on said boss intermediate said flanges for rotation between a first rotary limit position in which the releasable locking means is engaged and a second rotary limit position in which said locking means is disengaged whereby the pressure between said flanges created by screwing the flange lock onto a disk with the flanges separated by said balls raised up said ramp means can be relieved by releasing the balls such that the run down said ramp means due to the pressure of the flanges relieving the pressure between the inner flange and the disk and facilitating removal of the lock flange.

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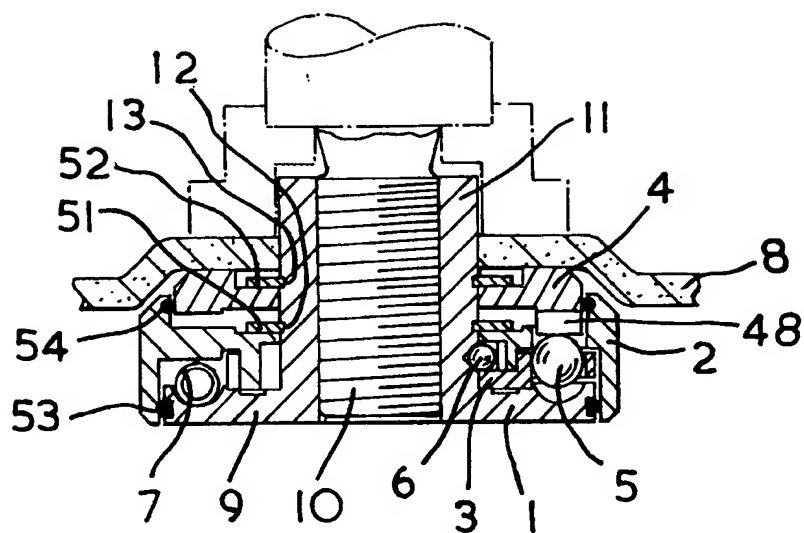


FIG. 1

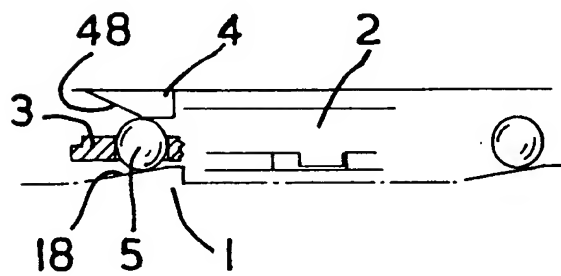


FIG. 6



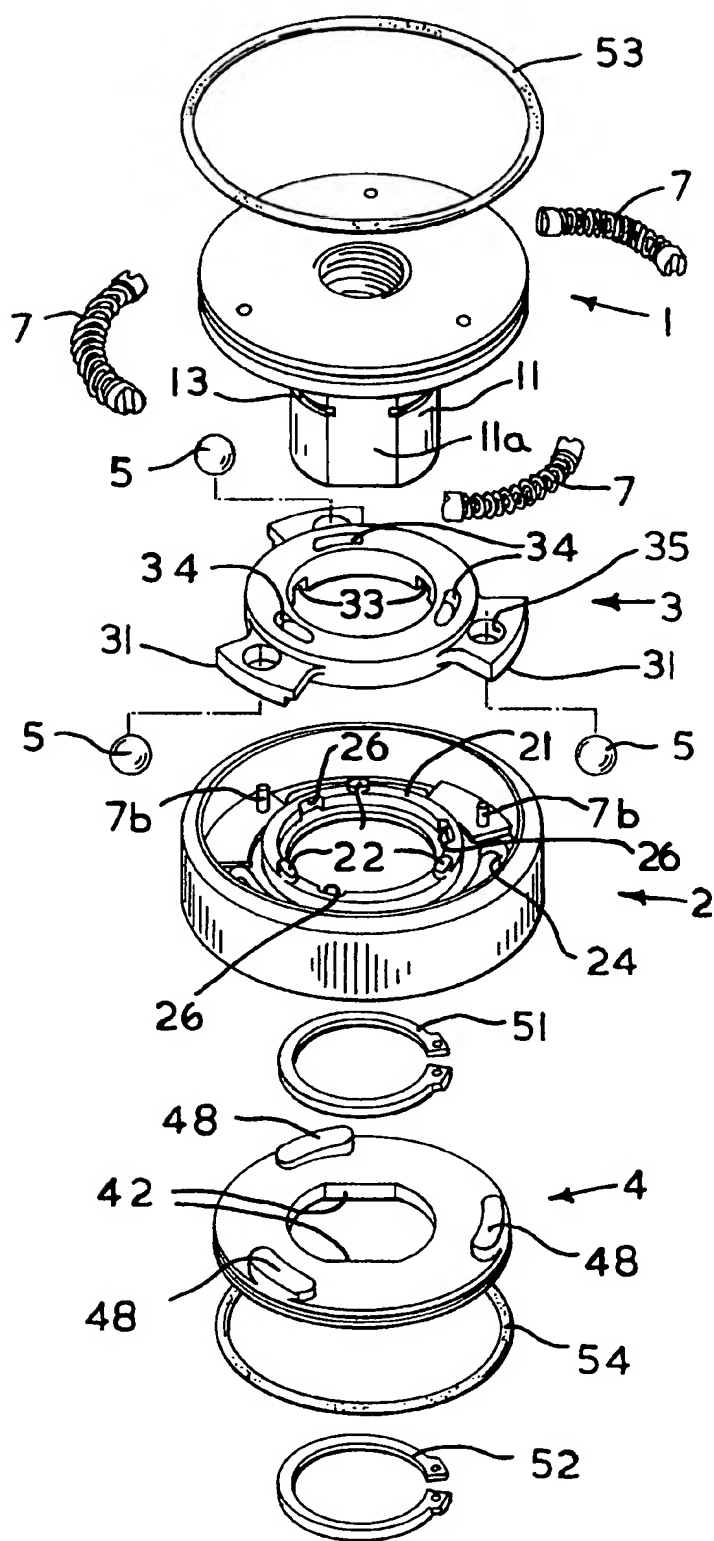


FIG. 2

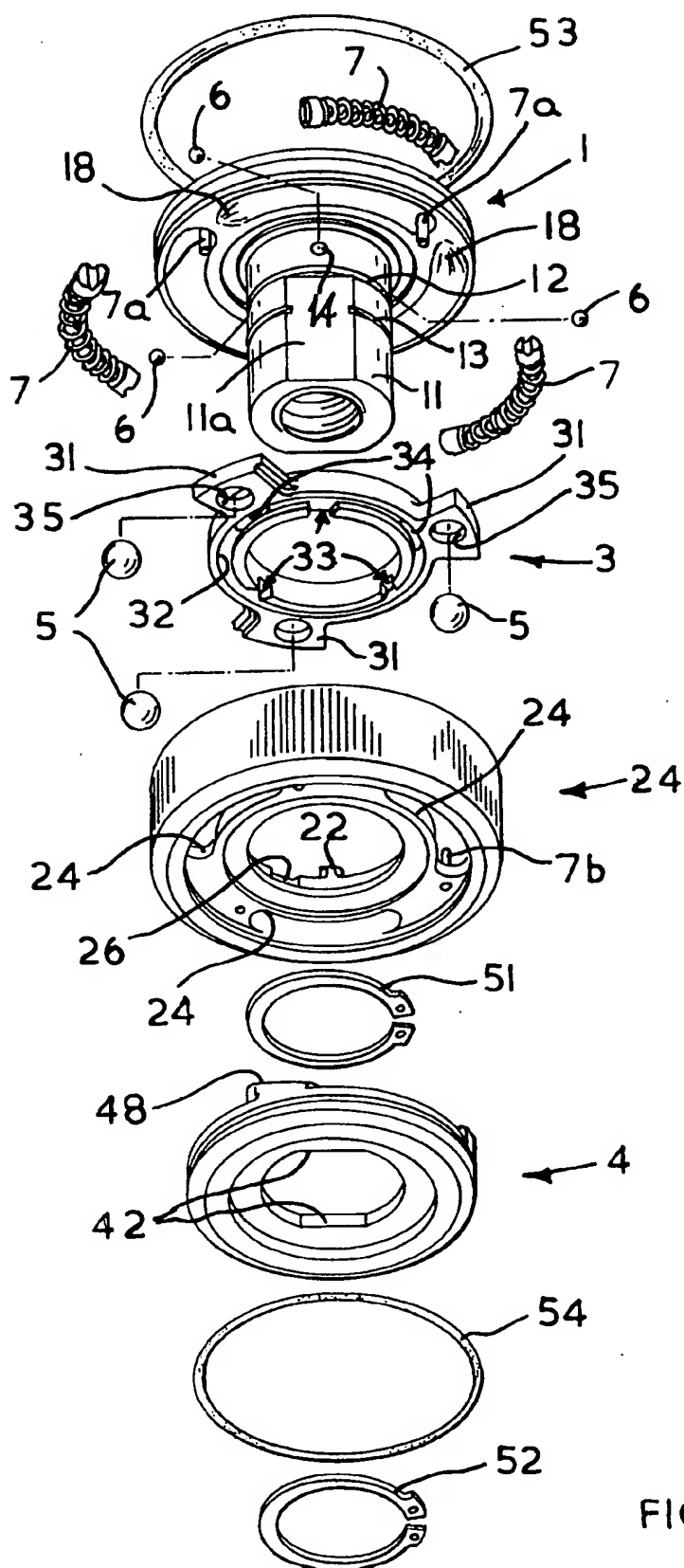


FIG. 3

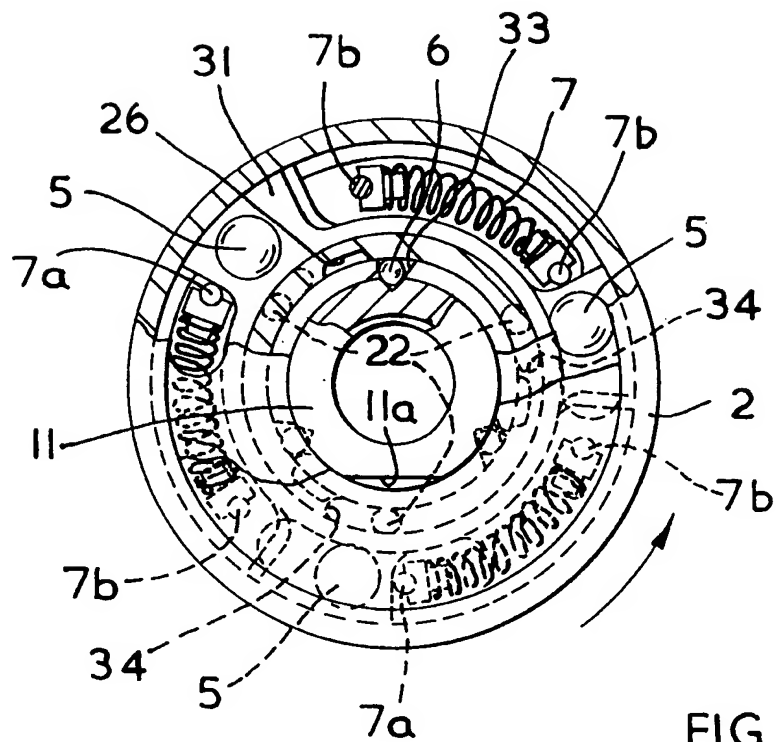


FIG. 4

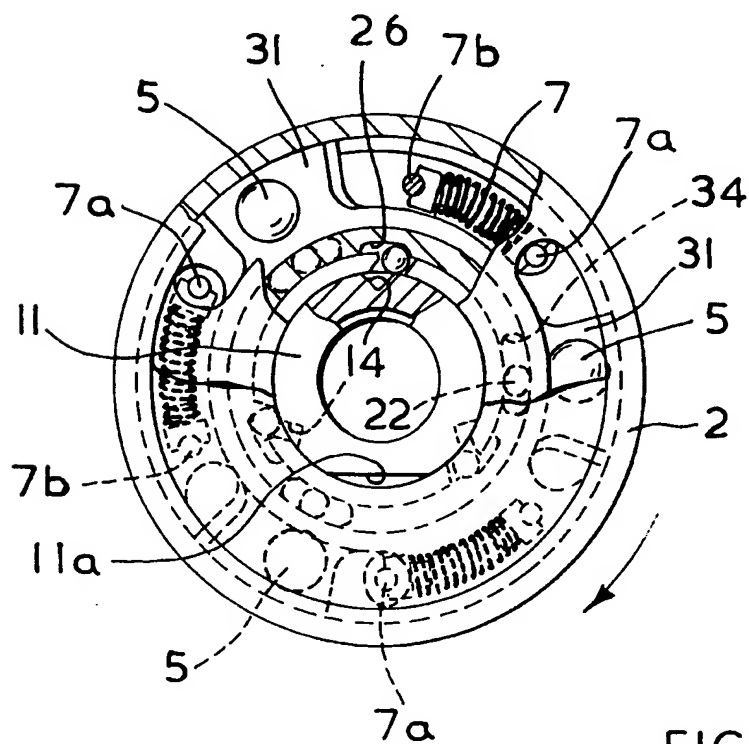


FIG. 5

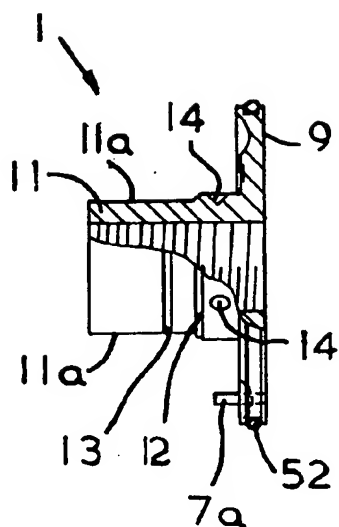


FIG. 7

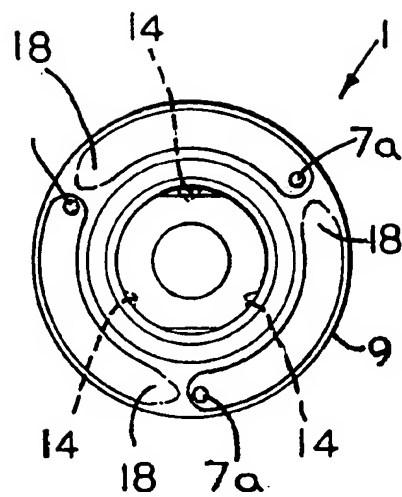


FIG. 8

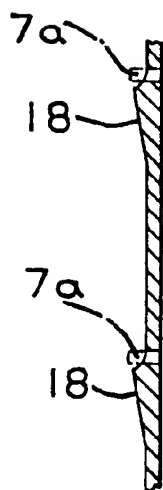


FIG. 9

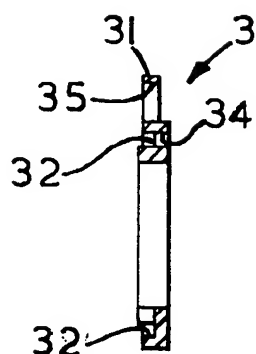


FIG. 11

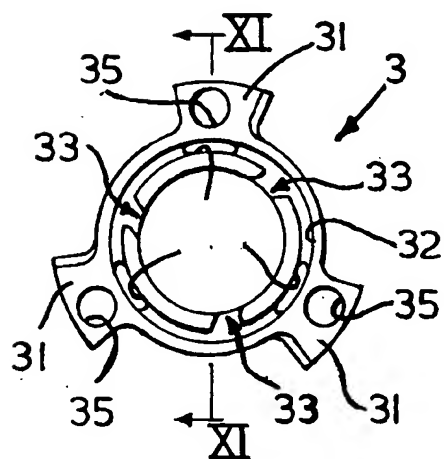


FIG. 10

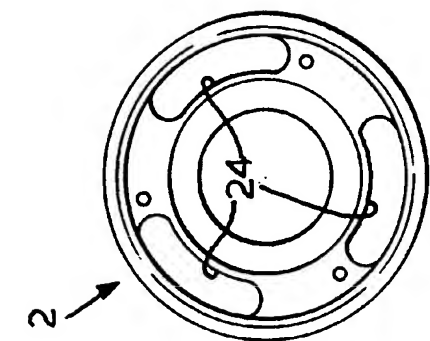


FIG. 13

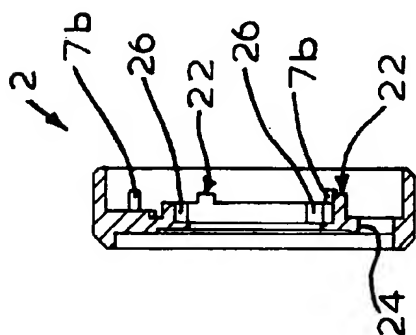


FIG. 14

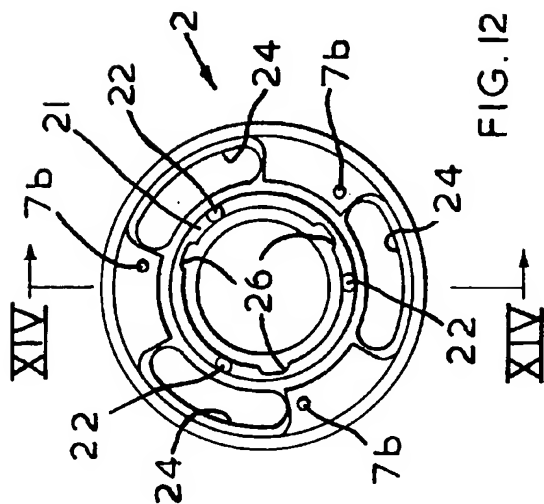


FIG. 12

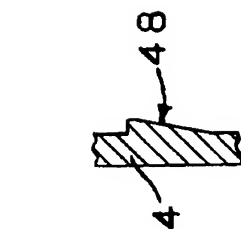


FIG. 17

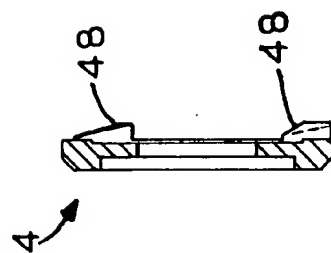


FIG. 16

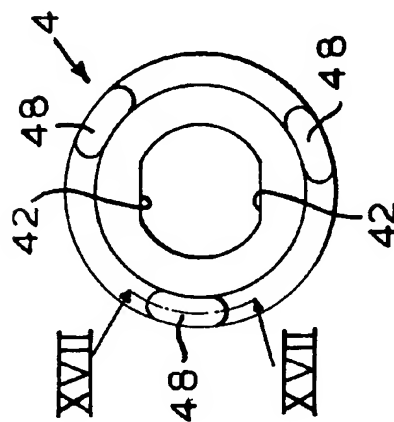


FIG. 15



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number

EP 93 30 1329

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DE-A-3 903 767 (LICENTIA PATENT- VERWALTUNGS- GMBH)	8	B24B45/00 B27B5/32
A	* the whole document * ---	1-7,9-21	
A	WO-A-8 804 975 (ROBERT BOSCH GMBH)  * abstract; figures 1,2 * ---	1,8,12, 21	
A,D	EP-A-0 381 809 (LICENTIA PATENT- VERWALTUNGS- GMBH) * abstract; figures 1,3 * ---	1-21	
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			B24B B27B
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 20 APRIL 1993	Examiner CUNY J.
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone  Y : particularly relevant if combined with another document of the same category  A : technological background  O : non-written disclosure  P : intermediate document</p> <p>T : theory or principle underlying the invention  E : earlier patent document, but published on, or after the filing date  D : document cited in the application  L : document cited for other reasons</p> <p>*****  @ : member of the same patent family, corresponding document</p>			

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